Temporal Assessment of Mental Disorders, Smoking, and Hazardous Drinking in United States Troops Deployed in Support of the Operations in Iraq and Afghanistan

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ABSTRACT

Context Combat exposure is known to increase the risk for mental disorders, however, little is known about the temporal relationship between mental disorders and alcohol or smoking.

Objective To prospectively investigate newly reported, persistent, and resolved mental disorders in association with newly reported, persistent, and resolved hazardous drinking and cigarette smoking, differentiating by deployment experience.

Design, Setting, and Participants The Millennium Cohort Study began in 2001, before the current military combat operations, and had obtained follow-up data from the first enrollment panel on over 55,000 participants approximately 3 years later.

Main Outcome Measures Posttraumatic stress disorder was assessed using the PTSD Checklist. Depression, panic, and other anxiety syndromes were assessed using the Primary Care Evaluation of Mental Disorders Patient Health Questionnaire. Self-reported use of cigarettes and hazardous drinking were also assessed. Positive screens for mental disorders were aggregated to investigate relationships with smoking and drinking behaviors.

Results A positive screen for a mental disorder at baseline or follow-up was associated with increased risk for newly reported hazardous drinking and relapse of smoking among past smokers. Among service members who screened negative for a mental disorder and did not report hazardous drinking or smoking at baseline, those who screened positive for a new-onset mental disorder at follow-up were also 1.51 times (95% confidence interval, 1.28-1.78) and 2.64 times (95% confidence interval, 2.20-3.14) more likely to report new smoking and new hazardous drinking, respectively.

Conclusions This study demonstrates that the onset of mental disorders may occur simultaneously with the uptake of smoking and alcohol use, although multiple temporal

sequence patterns exist to explain the relationship between mental disorders and hazardous drinking and smoking. Clinical approaches to mitigate deployment-related mental disorders should include alcohol and tobacco-related assessment and intervention.

Increased reporting of mental disorders including major depression and posttraumatic stress disorder (PTSD), as well as cigarette smoking and hazardous drinking, have been documented following combat-related deployment in support of the operations in Iraq and Afghanistan.[1-10] While combat stressors increase the risk for mental disorders, cigarette use, and hazardous drinking, understanding the temporal sequence of mental disorders with cigarette smoking and hazardous drinking as maladaptive mechanisms remains elusive.

The Millennium Cohort Study began collecting baseline data in July 2001 from a large population of US military members from all services and components.[11,12] The objective of this study was to prospectively investigate resolved, persistent, and new-onset mental disorder morbidity (based on positive screens for PTSD, depression, panic syndrome, and other anxiety syndrome) in conjunction with past, persistent, and newly reported cigarette smoking and hazardous drinking while adjusting for deployment in support of the operations in Iraq and Afghanistan.

METHODS

Population and Data Sources

Baseline (July 2001-June 2003) and follow-up (July 2004-February 2006) data from the Millennium Cohort Study were used to assess the interrelated nature of self-reported mental disorders, cigarette smoking, and hazardous drinking. Using military electronic deployment data, individuals with a complete deployment in support of the operations in Iraq and Afghanistan prior to follow-up were classified as having a 2001-2006 deployment. Participants who deployed and reported at follow-up witnessing death, trauma, injuries, prisoners of war, or refugees were considered to have combat-associated experiences. Those who submitted a questionnaire during

deployment or missing demographic, military, deployment, mental disorder screening, or key behavioral data were removed from all analyses.

Behavioral Assessment

Alcohol use was assessed in two ways: (1) the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR)[13]-defined maladaptive drinking was assessed using the PRIME-MD Patient Health Questionnaire (PHQ),[14-16] with at least one affirmative response indicating "problem drinking"; and (2) quantity/frequency of drinking was estimated by summing the number of standard drinks consumed on each day of the week prior to completing the questionnaire. Consumption of more than 14 drinks per week (men) and more than 7 drinks per week (women) indicated "heavy drinking," based on research that indicates drinking beyond this level may increase the risk for alcohol-related problems.[17-20] Therefore, screening positive for either problem or heavy drinking was classified as hazardous drinking.

Self-reported cigarette smoking was assessed at baseline and follow-up. Although any degree of smoking is hazardous,[21] current smokers were identified if they answered that they had smoked at least 100 cigarettes in their lifetime, and had smoked in the last year or had not successfully quit smoking.

Mental Disorders

The PTSD Checklist-Civilian Version (PCL-C)[22] and the PHQ are standardized instruments imbedded in the Millennium Cohort questionnaire. Based on self-reported answers from the PCL-C, participants screened positive for PTSD if they reported a moderate or higher level of at least one intrusion symptom, three avoidance symptoms, and two hyperarousal

symptoms during the 30 days prior to survey completion (DSM-IV-TR criteria). This approach has been shown to have high sensitivity[23] and high internal consistency, as measured using Cronbach's alpha (alpha=0.94).[24] Using the standardized methods, panic syndrome, other anxiety syndrome, and depression were assessed using the PHQ instrument.[16] An aggregated mental disorder variable was created, indicating a positive screen for one or more of the following: PTSD, depression, panic syndrome, and other anxiety syndrome. Additionally, participants who self-reported having been diagnosed with PTSD, depression, manic-depressive disorder, or schizophrenia or psychosis at baseline were indicated as having a prior mental disorder diagnosis.

Assessment of the Behavioral and Mental Disorder Metrics

Participants were classified both at baseline and follow-up as to whether they screened positive for a mental disorder, smoking, or hazardous drinking. Participants were classified as having a new-onset mental disorder, or newly reported smoking or hazardous drinking if they screened negative at baseline but positive at follow-up. Participants were identified as having a resolved mental disorder or hazardous drinking if they screened positive at baseline but negative at follow-up. Finally, participants who screened positive for a mental disorder, smoking, or hazardous drinking at baseline *and* follow-up were classified as persistent. For smoking status, participants were additionally classified as (1) past smoker, if they reported successfully quitting after smoking at least 100 cigarettes in their lifetime; (2) quit smoker, if they screened positive at baseline, but not at follow-up; and (3) relapsed smoker, if they were a past smoker at baseline, but reported smoking at follow-up. In summary, all outcomes were based upon screening positive using the PCL-C, PHQ, and smoking questions.

Statistical Analyses

Descriptive and univariate analyses compared characteristics by baseline, follow-up, and new-onset mental disorder status, prior to full analyses. Multivariable logistic regression models were built to calculate the adjusted odds of new-onset mental disorders associated with the several categories of smoking and hazardous drinking. Similarly, multivariable models were used to examine the association of newly reported smoking and hazardous drinking with resolved, new-onset, or persistent mental disorders. Hierarchical models were used to investigate these outcomes in the context of (1) demographic and military characteristics; (2) demographic, military characteristics, and deployment-related variables; and (3) demographic, military characteristics, deployment-related variables, as well as prior mental disorder diagnosis and alcohol/CAGE questionnaire at baseline. Additionally, four models were designed to calculate adjusted odds of new-onset and newly reported outcomes independent of other comorbidities and behaviors among those who did not report smoking, alcohol/CAGE at baseline, or prior mental disorder diagnosis. Data management and statistical analyses were performed using SAS software, version 9.2 (SAS Institute, Inc., Cary, NC).

RESULTS

Of the 77 047 Millennium Cohort participants who completed a baseline questionnaire between 2001 and 2003, 1085 completed the questionnaire while deployed and another 2404 were missing baseline demographic, military, deployment, mental disorder, or behavioral data, leaving 73 558 for baseline analyses. Of participants who completed a baseline questionnaire, 55 021 completed a follow-up questionnaire between 2004 and 2006. Of these participants, 3657

completed a questionnaire while deployed and another 1336 were missing baseline demographic, military, deployment data, or follow-up mental disorder or behavioral data, leaving 50 028 for follow-up analyses. There were 49 289 participants who met criteria for both baseline and follow-up analyses; and of those, 2865 screened positive for a baseline mental disorder and were excluded, leaving 46 424 follow-up responders with a negative screen for a baseline mental disorder, and eligible for new-onset mental disorder analyses.

Both at baseline and follow-up, 6.7% of participants screened positive for at least one mental disorder. Of participants who screened negative for all mental disorders at baseline, 1999 (4.3%) screened positive for at least one at follow-up. Participants who smoked increased from 17.2% at baseline to 22.9% at follow-up. Of those who reported not smoking at baseline, 4380 (10.5%) reported smoking at follow-up. Conversely, self-reported hazardous drinking decreased between baseline and follow-up from 16.4% to 12.8%. Of those participants who did not report baseline hazardous drinking, 2841 (6.8%) newly reported hazardous drinking at follow-up.

Baseline, demographic, and military characteristics of included participants are shown in Table 1. Across the three groups, participants who screened positive for a baseline, follow-up, or new-onset mental disorder were proportionately more likely to be female, younger, less educated, not married, Army or Air Force members, enlisted, deployed in support of the operations in Iraq and Afghanistan with combat experiences, and deployed to the 1990-1991 Gulf War. They were also more likely to report a mental disorder diagnosis or screen positive for alcohol/CAGE at baseline.

Baseline, follow-up, and newly reported alcohol-related problems and smoking were more common among participants who deployed in support of the operations in Iraq and

Afghanistan with combat experiences, screened positive for alcohol/CAGE at baseline, or screened positive for at least one mental disorder at baseline, follow-up, or new-onset (Table 2).

Using the population without mental disorders at baseline (n=46 424), multivariable logistic regression revealed a statistically significant association of new-onset mental disorders with smoking and hazardous drinking (Table 3). The unadjusted and adjusted models showed similar trends of statistical significance, while in general, the magnitude of the associations decreased with increasing adjustment. All smokers, except those who quit between baseline and follow-up, were at greater odds for new-onset mental disorders compared with never smokers. Participants with resolved, newly reported, or persistent hazardous drinking were also at increased odds for new-onset mental disorders. In the fully adjusted models (Model 4 structure), the strongest associations of new-onset mental disorders were among those who newly reported smoking or hazardous drinking (odds ratio [OR], 1.82; 95% confidence interval [CI], 1.28-2.59 and OR, 2.49; 95% CI, 2.15-2.89, respectively).

Of the 49 289 participants who met criteria for both baseline and follow-up analyses, 7530 were smokers at baseline and excluded from the newly reported smoking analyses, leaving 41 759 participants (Table 3). The sample was then stratified by previous smoking status; one model for never smokers (n=29 250) and another for past smokers (n=12 509). In both models, newly reported or relapse of smoking had a statistically significant positive association with new-onset or persistent mental disorder symptoms that remained even after adjustment for demographic, military, deployment, baseline mental disorder diagnosis, and baseline behavioral data. While those with resolved, new-onset, or persistent mental disorders had similar odds of relapse of smoking, never smokers with persistent mental disorders had the greatest likelihood for newly reported smoking at follow-up. Those with resolved mental disorders were not at

increased odds for newly reported smoking compared with those who screened negative for mental disorders.

For the analysis of newly reported hazardous drinking, 7475 participants who reported hazardous drinking at baseline were excluded, leaving 41 814 (Table 3). While the magnitude of the association decreased with adjustment, participants who had resolved, new-onset, or persistent mental disorders were at significantly increased odds for newly reported hazardous drinking. Those with new-onset mental disorders had the greatest odds for newly reported hazardous drinking (OR, 2.72; 95% CI, 2.34-3.15), followed by those with persistent and resolved mental disorders, respectively.

To separately examine those who did not screen positive for smoking, hazardous drinking, or mental disorders at baseline, additional multivariable models were built (Table 4). Of the 49 289 participants meeting criteria for baseline and follow-up analyses, 34 081 reported no hazardous drinking, no smoking, and screened negative for all mental disorders at baseline. After adjustment for demographic, military, deployment, alcohol/CAGE, and baseline mental disorder diagnoses, individuals who screened positive for new-onset mental disorders at follow-up were also more likely to newly report smoking (OR, 1.51; 95% CI, 1.28-1.78) and hazardous drinking (OR, 2.64; 95% CI, 2.22-3.14) at follow-up. Newly reported smoking was stratified by previous smoking status, therefore two models (never smokers and past smokers) were performed. In both models, those who newly reported smoking or relapsed to smoking were at increased odds for new-onset mental disorders, as well as newly reported hazardous drinking, with the magnitude of the associations being greater for newly reported smoking in comparison with smoking relapse. Newly reported hazardous drinking was also associated with new-onset

mental disorders (OR, 2.59; 95% CI, 2.18-3.08) and newly reported smoking (OR, 2.52; 95% CI, 2.24-2.84) (Table 4).

COMMENT

Understanding the long-term health impact of military service, especially combat deployment, involves a multitude of occupational exposures, stressors, and family and social support structures. An important component includes the temporal progression of mental disorders and maladaptive behaviors. This study highlights the complex temporal relations between mental disorders and maladaptive behaviors, independent of other conditions and behaviors. Further, this study provides evidence that there are numerous, bidirectional temporal sequences that exist to explain condition and behavior comorbidities.

Previous studies have explored the relations between mental disorders, smoking, and alcohol. The majority support positive associations that exist in one temporal direction. That is, existing mental disorders are associated with new-onset smoking or hazardous drinking, and conversely, current smoking and/or hazardous drinking are associated with new-onset mental disorders. For example, studies report positive associations between dysthymia and continued smoking,[25] PTSD and incident nicotine dependence,[26] smoking and onset of psychiatric disorders,[27,28] and psychiatric disorders and stages of smoking.[29] Similar relations are known to exist between smoking and hazardous drinking.[30,31] Explanations for the etiology of these comorbidities includes genetics, familial characteristics, environmental factors, and the emerging understanding of pharmacodynamic interactions, including the effect of chronic drug exposure (such as nicotine and alcohol) toward persisting brain changes (plasticity).[32-34]

A novel finding was that the adjusted odds for newly reported smoking was greatest among those who persistently screened positive for a mental disorder, whereas the adjusted odds for smoking relapse were similar across resolved, new-onset, and persistent mental disorders. To observe increased odds of newly reported smoking among those with persistent mental disorders is plausible. These individuals may turn to smoking as a perceived way to decrease long-term stress,[7,35,36] or to stimulate the brain reward system[37,38] to counteract the emotional numbing that often accompanies mental disorders. Observing approximately equal odds of smoking relapse among those with resolved, new-onset, and persistent mental disorders is less intuitive. Independent nicotine relapse variables may play a stronger role in smoking relapse than does mental health status.

While the prevalence of hazardous drinking actually decreased from baseline to follow-up, it is noteworthy that newly reported hazardous drinking was most common and strongly associated with new-onset mental disorders. Risk factors for hazardous drinking included traumatic or stressful experiences,[39,40] which additionally are risk factors common to mental disorders.[41-43] Similarly, previous investigations of this Cohort found that combat experiences increase the risk for heavy weekly drinking, binge drinking, and alcohol-related problems, as well as increase the risk for new-onset mental disorders.[4,6,8] Therefore, because this study consistently observed these as co-occurring, postdeployment screening should target emergent newly reported smoking or hazardous drinking, or smoking relapse, to reduce progression from hazardous drinking to an alcohol use disorder, and, possibly, early identification of new-onset mental disorders.

This study has limitations that should be noted. While baseline assessments of mental disorders were measured prior to deployment, it is possible that individuals may have

experienced a disorder prior to baseline, which we could not measure. We also could not measure every potential confounder that could be associated with mental disorders, smoking, or drinking, such as illicit drug use or social support structures. Underreporting of mental disorder symptoms, including provider-diagnosed mental disorder, smoking, or drinking may have occurred due to the perceived stigma associated with these conditions. It is also possible that under-screening for hazardous drinking may have occurred, since the questionnaire includes only two of ten questions of Alcohol Use Disorders Identification Test (AUDIT).[44] The degree to which underreporting or under-screening may have biased study findings depends on the extent to which these conditions were differential with respect to exposed and unexposed groups, which is assumed to be minimal. Also, among participants who screened positive for a mental disorder, smoking, and hazardous drinking simultaneously, it was not possible to detect which occurred first. Finally, while the Millennium Cohort was selected using weighted random sampling from all personnel on rosters in October 2000, the Cohort may not be representative of the entire military or those who deploy; however, many published efforts have highlighted a representative population of military personnel who report reliably with minimal health related tendency for enrollment, and showed little nonresponse bias at the first follow-up.[11,24,45-51]

This is the first longitudinal study to examine the complex relations between mental disorders and maladaptive behaviors in a large military population that includes all branches of service, as well as both active duty and Reserve/National Guard. In addition, while deployment itself is a broad measure of exposure, we also assessed combat experiences, which, in previous studies, have been shown to be predictive of mental disorders and maladaptive behaviors.[6-8] This study also leveraged the ability to adjust for demographic, military, previous mental disorder diagnoses, and behavioral characteristics at baseline, which were measured predeployment

among those who deployed. This study was also unique in its ability to examine multiple scenarios and combinations of mental disorders in conjunction with smoking and hazardous drinking, especially with a temporal assessment for new-onset conditions. As additional longitudinal data points become available, these complex relations may be further elucidated.

Though much is known about mental disorder comorbidities and associated maladaptive behaviors, there is little known about the temporal sequence of these outcomes in the context of military deployment. In this study, findings support the association of maladaptive behaviors and mental disorders at baseline while highlighting increased new-onset mental disorders in conjunction with newly reported maladaptive behaviors in a population without reported mental disorder diagnoses or behaviors at baseline. Investigating the temporal progression of symptoms or illnesses and maladaptive behaviors contributes to understanding the possible health impact of military service and especially combat deployments. Findings highlight the need for mental health screening at substance abuse treatment facilities and vice versa, including attention to smoking. Clinical approaches to mitigate mental disorders should focus on early identification and treatment, which may limit maladaptive behaviors and additional mental disorder morbidity.

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Study concept and design: T Smith, LeardMann, Wells, Jacobson, Boyko, Ryan, B Smith.

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Table 1. Baseline Demographic and Military Characteristics of Millennium Cohort Members by Mental Disorder Screening Status

Characteristic	Baseline Survey Responders			Follow-Up Survey Responders			Follow-Up Responders Without Baseline Mental Disorder[a]		
	All Responders n = 73 558	Baseline mental Disorder[b] n = 4901 (%)		All Responders n = 50 028	Follow-Up Mental Disorder[c] n = 3337 (%)		All Responders n = 46 424	New-Onset Mental Disorder[d] n = 1999 (%)	
Sex									
Male	53 674	3107	(5.8)	36 405	2097	(5.8)	34 045	1268	(3.7)
Female	19 884	1794	(9.0)	13 623	1240	(9.1)	12 379	731	(5.9)
Birth year									
Pre-1960	15 867	842	(5.3)	12 604	689	(5.5)	11 746	397	(3.4)
1960-1969	26 980	1525	(5.5)	20 315	1212	(6.0)	19 052	747	(3.9)
1970-1979	25 426	2025	(8.0)	15 087	1186	(7.9)	13 859	708	(5.1)
1980 and later	4285	509	(11.9)	2022	250	(12.4)	1767	147	(8.3)
Race/ethnicity									
White non-Hispanic	35 729	3315	(9.3)	35 706	2317	(6.5)	33 157	1389	(4.2)
Black non-Hispanic	18 840	1018	(5.4)	6043	474	(7.8)	5554	272	(4.9)
Other	18 989	568	(3.0)	8279	546	(6.6)	7713	338	(4.4)
Education									
High school or less	33 067	3408	(9.3)	21 468	2074	(9.7)	19 303	1214	(6.3)
Some college	18 105	1032	(5.4)	13 489	743	(5.5)	12 617	435	(3.4)
Bachelor's degree or higher	18 619	576	(3.0)	15 071	520	(3.5)	14 504	350	(2.4)
Marital status									
Not married	27 005	2275	(8.4)	16 673	1406	(8.4)	15 214	831	(5.5)
Married	46 553	2628	(5.6)	33 355	1931	(5.8)	31 210	1168	(3.7)
Service branch									
Army	34 849	2817	(8.1)	23 169	2000	(8.6)	21 135	1205	(5.7)
Navy/Coast Guard	21 497	901	(4.2)	15 478	625	(4.0)	14 735	385	(2.6)
Marine Corps	13 453	871	(6.5)	9320	561	(6.0)	8645	324	(3.7)
Air Force	3759	312	(8.3)	2061	151	(7.3)	1909	85	(4.5)
Service component									
Reserve/National Guard	31 754	1944	(6.1)	22 141	1457	(6.6)	20 565	891	(4.3)
Active duty	41 804	2957	(7.1)	27 887	1880	(6.7)	25 859	1108	(4.3)
Military pay grade									
Enlisted	56 469	4466	(7.9)	36 404	2918	(8.0)	33 249	1713	(5.2)
Officer	17 089	435	(2.5)	13 624	419	(3.1)	13 175	286	(2.2)

Table 1. Baseline Demographic and Military Characteristics of Millennium Cohort Members by Mental Disorder Screening Status (cont.)

Occupational category									
Combat specialist	14 699	806	(5.5)	10 039	541	(5.4)	9476	335	(3.5)
Health care specialist	7745	477	(6.2)	5755	341	(5.9)	5392	196	(3.6)
Service supply/functional support	21 207	1582	(7.5)	14 514	1057	(7.3)	13 345	629	(4.7)
Other occupation	29 907	2036	(6.8)	19 720	1398	(7.1)	18 211	839	(4.6)
2001-2006 deployment[e]									
No deployment	70 580	4747	(6.7)	37 034	2462	(6.6)	34 243	1401	(4.1)
Deployed without combat	1528	48	(3.1)	6923	263	(3.8)	6573	184	(2.8)
Deployed with combat	1450	106	(7.3)	6071	612	(10.1)	5608	414	(7.4)
1990-2000 deployment									
None	46 053	3134	(6.8)	31 088	2091	(6.7)	28 859	1286	(4.5)
1990-1991 Gulf War	5436	493	(9.1)	3989	381	(9.6)	3594	198	(5.5)
1998-2000 Southwest Asia, Bosnia, or Kosovo	18 653	1086	(5.8)	12 464	732	(5.9)	11 643	436	(3.7)
Deployed to both operations	3416	188	(5.5)	2487	133	(5.3)	2328	79	(3.4)
Prior mental disorder diagnosis[f]									
No	67 773	3038	(4.5)	46 094	2333	(5.1)	43 683	1627	(3.7)
Yes	5785	1863	(32.2)	3934	1004	(25.5)	2741	372	(13.6)
Alcohol/CAGE[g]									
No	59 888	3270	(5.5)	40 966	2399	(5.9)	38 439	1503	(3.9)
Yes	13 670	1631	(11.9)	9062	938	(10.4)	7985	496	(6.2)

Abbreviations: DSM-IV-TR, *Diagnostic and Statistical Manual of Mental Disorders, 4th Edition, Text Revision;* PCL-C, PTSC Checklist; PHQ, PRIME-MD Patient Health Questionnaire; PTSD, posttraumatic stress disorder.;

[a]Participants who screened negative for the following at baseline: major depression, other anxiety syndrome, panic syndrome based on the PHQ, and PTSD symptoms based on PCL-C and DSM-IV-TR criteria.

Participants who screened positive for one or more of the following at baseline: major depression, other anxiety syndrome, panic syndrome based on the PHQ, and PTSD symptoms based on PCL-C and DSM-IV-TR criteria.

[c]Participants who screened positive for one or more of the following at follow-up: major depression, other anxiety syndrome, panic syndrome based on the PHQ, and PTSD symptoms based on PCL-C and DSM-IV-TR criteria.

[d]Participants who screened positive for one or more of the following at follow-up, but not at baseline: major depression, other anxiety syndrome, panic syndrome based on the PHQ, and PTSD symptoms based on PCL-C and DSM-IV-TR criteria.

[e]Deployment in support of the wars in Iraq and Afghanistan prior to follow-up. Combat experiences included reporting exposure to witnessing death, abuse, maimed soldiers or civilians, prisoners of war, or refugees.

[f]At baseline, reported being told by a doctor or other health professional of having one or more of the following conditions: depression, schizophrenia or psychosis, manic-depressive disorder, or PTSD.

[g]At baseline, participant self-reported ever feeling at least one of the following: (1) need to cut back on drinking, (2) annoyed at anyone who suggested to cut back on drinking, (3) guilty about drinking, and (4) a need for an “eye-opener,” or early morning drink.

Table 2. Frequencies of Smoking and Hazardous Drinking by Deployment and Mental Disorder Characteristics of Millennium Cohort Members

	Hazardous drinking[a]			Smoking		
	Baseline N=73,558	Follow-up N=50,028	Newly reported[b] N=41,814	Baseline N=73,558	Follow-up N=50,028	Newly reported[b] N=41,759
	%[c]	%	%	%	%	%
1990-2000 deployment						
None	16.7	12.5	6.8	16.8	21.4	10.3
1991 Gulf War	14.4	11.2	6.2	15.3	20.4	9.7
1998-2000 Southwest Asia, Bosnia or Kosovo	16.7	12.2	7.0	18.7	23.9	11.4
Deployed to both	13.1	10.7	6.2	17.7	21.1	9.4
2001-2006 deployment[d]						
Not deployed	16.4	11.9	6.5	17.0	20.5	9.7
Deployed without combat	13.9	11.5	6.4	20.6	23.7	11.2
Deployed with combat	16.7	15.2	9.3	22.5	28.5	15.0
Baseline mental disorders[e]						
No	15.3	12.3	6.6	16.3	21.9	10.1
Yes	31.4	22.1	11.3	29.4	36.8	18.4
Follow-up mental disorders[f]						
No		11.6	6.2		21.2	9.9
Yes		26.9	15.9		37.0	19.9
New-onset mental disorders[g]						
No		11.6	6.2		21.2	9.7
Yes		26.9	16.9		37.0	19.2
Alcohol/CAGE[h]						
No	9.5	8.3	5.6	15.6	20.1	9.4
Yes	46.2	31.4	15.7	24.2	30.4	15.8

Abbreviations: DSM-IV-TR, *Diagnostic and Statistical Manual of Mental Disorders, 4th ed., Text Revision*; PCL-C, PTSD Checklist; PHQ, Patient Health Questionnaire PRIME-MD; PTSD, posttraumatic stress disorder.
Note: Data cannot be calculated for the blank cells, since participants cannot screen positive for a follow-up or new-onset mental disorder at baseline.
[a]Reported hazardous drinking, defined as either heavy drinking (more than 7 or 14 alcoholic drinks in the week before completing the questionnaire for women and men, respectively), or problem drinking (reported one or more PHQ alcohol-related problems).
[b]Reported hazardous drinking on the follow-up questionnaire, but not on the baseline questionnaire.
[c]For each deployment or mental disorder category, the percentage of participants who reported the certain behavior.
[d]Deployment in support of the wars in Iraq and Afghanistan prior to completing the baseline or follow-up questionnaire.
[e]Participants who screened positive for one or more of the following at baseline: major depression, other anxiety syndrome, panic syndrome, PTSD.
[f]Participants who screened positive for one or more of the following at follow-up: major depression, other anxiety syndrome, panic syndrome, PTSD.
[g]Participants who screened positive for one or more of the following at follow-up, but not at baseline: major depression, other anxiety syndrome, panic syndrome, and PTSD.
[h]At baseline, participant self-reported ever feeling at least one of the following: (1) need to cut back on drinking, (2) annoyed at anyone who suggested to cut back on drinking, (3) guilty about drinking, and (4) a need for an "eye-opener," or early morning drink.

Table 3. Unadjusted and Adjusted Odds of New Onset Mental Disorders and Maladaptive Behaviors of the Millennium Cohort Members

Outcome	Main Exposures	Model 1: Unadjusted OR (95% CI)	Model 2: Adjusted for Demographics and Military Data OR (95% CI) [a]	Model 3: Adjusted for Demographics, Military, and Deployment Data OR (95% CI) [b]	Model 4: Fully Adjusted OR (95% CI) [c]
New-onset mental disorder (n = 46 424)	Smoking				
	Never	1.00	1.00	1.00	1.00
	Past	1.24 (1.10-1.86)	1.25 (1.10-1.42)	1.26 (1.11-1.44)	1.22 (1.07-1.39)
	Quit	1.33 (0.95-1.86)	1.20 (0.85-1.68)	1.21 (0.86-1.70)	1.16 (0.82-1.63)
	Relapsed	1.93 (1.66-2.23)	1.65 (1.42-1.92)	1.63 (1.40-1.89)	1.53 (1.31-1.78)
	Newly reported	2.53 (1.80-3.55)	1.90 (1.34-2.69)	1.83 (1.29-2.59)	1.82 (1.28-2.59)
	Persistent	1.96 (1.73-2.21)	1.62 (1.42-1.84)	1.60 (1.41-1.82)	1.51 (1.33-1.72)
	Hazardous drinking				
	Never	1.00	1.00	1.00	1.00
	Resolved	1.42 (1.22-1.67)	1.36 (1.16-1.60)	1.37 (1.16-1.60)	1.24 (1.05-1.46)
	Newly reported	2.71 (2.35-3.12)	2.59 (2.24-2.99)	2.56 (2.21-2.96)	2.49 (2.15-2.89)
	Persistent	2.40 (2.09-2.76)	2.35 (2.04-2.70)	2.33 (2.02-2.69)	2.08 (1.79-2.44)
Newly reported smoking among nonsmokers (n = 29 250)	Mental disorder				
	None	1.00	1.00	1.00	1.00
	Resolved	1.35 (0.79-2.31)	0.98 (0.57-1.68)	1.00 (0.58-1.72)	0.91 (0.52-1.59)
	New-onset	3.10 (2.22-4.35)	2.31 (1.64-3.26)	2.15 (1.52-3.05)	2.07 (1.46-2.95)
	Persistent	4.05 (2.73-6.01)	3.24 (2.16 -4.86)	3.29 (2.19 -4.96)	2.84 (1.84-4.39)
Smoking relapse among past smokers (n = 12 509)	Mental disorder				
	None	1.00	1.00	1.00	1.00
	Resolved	1.69 (1.39-2.05)	1.47 (1.19-1.80)	1.47 (1.19-1.81)	1.38 (1.12-1.70)
	New-onset	1.76 (1.49-2.09)	1.48 (1.24-1.77)	1.45 (1.21-1.74)	1.40 (1.17-1.68)
	Persistent	1.78 (1.44-2.20)	1.44 (1.15-1.80)	1.46 (1.17-1.83)	1.35 (1.07-1.70)
Newly reported hazardous drinking (n = 41 814)	Mental disorder				
	None	1.00	1.00	1.00	1.00
	Resolved	1.54 (1.25-1.89)	1.42 (1.15-1.75)	1.42 (1.15-1.75)	1.31 (1.06-1.63)
	New-onset	3.10 (2.70-3.57)	2.84 (2.46-3.28)	2.79 (2.42-3.23)	2.72 (2.34-3.15)
	Persistent	2.51 (2.07-3.05)	2.30 (1.88-2.80)	2.29 (1.88-2.79)	2.12 (1.72-2.62)

Abbreviations: CI, confidence interval; OR, odds ratio.

[a]Models adjusted for sex, birth year, race/ethnicity, education, marital status, service branch, service component, military pay grade, and occupation.

[b]Models adjusted for sex, birth year, race/ethnicity, education, marital status, service branch, service component, military pay grade, occupation, 1990-2000 deployment experience, and 2001-2006 deployment experience.

[c]Models adjusted for sex, birth year, race/ethnicity, education, marital status, service branch, service component, military pay grade, occupation, 1990-2000 deployment experience, and 2001-2006 deployment experience, alcohol/CAGE, and prior mental health diagnosis.

Table 4. Adjusted Odds of Newly-Reported Mental Disorder and Maladaptive Behaviors Among Participants Who Screened Negative at Baseline

Outcome	Main Exposures	OR (95% CI) [a]
New-onset mental disorder (n = 34 081)	Newly reported smoking	
	No	1.00
	Yes	1.51 (1.28-1.78)
	Newly reported hazardous drinking	
	No	1.00
	Yes	2.64 (2.2-3.14)
Newly reported smoking among non-smokers (n = 25 179)	New-onset mental disorder	
	No	1.00
	Yes	2.04 (1.37-3.03)
	Newly reported hazardous drinking	
	No	1.00
	Yes	3.54 (2.63-4.77)
Smoking relapse among past smokers (n = 9622)	New-onset mental disorder	
	No	1.00
	Yes	1.35 (1.09-1.67)
	Newly reported hazardous drinking	
	No	1.00
	Yes	2.02 (1.72-2.37)
Newly reported hazardous drinking (n = 34 081)	New-onset mental disorder	
	No	1.00
	Yes	2.59 (2.18-3.08)
	Newly reported smoking	
	No	1.00
	Yes	2.52 (2.24-2.84)

Abbreviations: CI, confidence interval; OR, odds ratio.

[a]Models adjusted for sex, birth year, race/ethnicity, education, marital status, service branch, service component, military pay grade, occupation, 1990-2000 deployment experience, 2001-2006 deployment experience, alcohol/CAGE, and prior mental health diagnosis. New-onset smoking model also adjusted for prior smoking status.

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14. ABSTRACT

Combat exposure is known to increase the risk for mental disorders. However, little is known about the temporal relationship between mental disorders and alcohol or smoking. A positive screen for a mental disorder at baseline or follow-up was associated with increased risk for newly reported hazardous drinking and relapse of smoking among past smokers. Among service members who screened negative for a mental disorder and did not report hazardous drinking or smoking at baseline, those who screened positive for a new-onset mental disorder at follow-up were also 1.51 times (95% confidence interval [CI], 1.28–1.78) and 2.64 times (95% CI, 2.20–3.14) more likely to report new smoking and new hazardous drinking, respectively. Differentiating by recent deployment status and including all services as well as active duty and Reserve/National Guard members, this study demonstrates that multiple temporal sequence patterns exist to explain the relationship between mental disorders and hazardous drinking and smoking, and these patterns are not easily distinguished by demographic or behavioral characteristics. Clinical approaches to mitigate deployment-related mental disorders should include alcohol and tobacco-related assessment and intervention.

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